# solplan review

the independent newsletter of energy efficient building practice

**the drawing-room graphic services ltd.**
box 86627 north vancouver b.c. V7L 4L2

No. 12

December-January 1987

## INSIDE....

Fireplaces remain a favorite feature of homeowners for their aesthetic value, not necessarily for their energy features. Greg Allen presents a case for open hearth fireplaces that are both efficient and practical. He suggests that even in the tightest house it should be possible to build and maintain a fireplace without penalty. Some typical details are offered.

Ventilation in houses remains an issue that arouses much interest. We present comments on the proposed new ASHRAE standards, and an overview of new R-2000 Program ventilation criteria. While ASHRAE is suggesting an increase, based on monitoring experience the R-2000 program is reducing ventilation rates.

Backdrafting from combustion appliances is a serious problem as in extreme cases it can lead to death. We present a brief introduction to some of the issues that were uncovered during recent studies.

Other items include product updates on a new HRV, radiant heating system warranty changes, a new renovation work warranty program, reviews of new books, and a LEBCO commentary.

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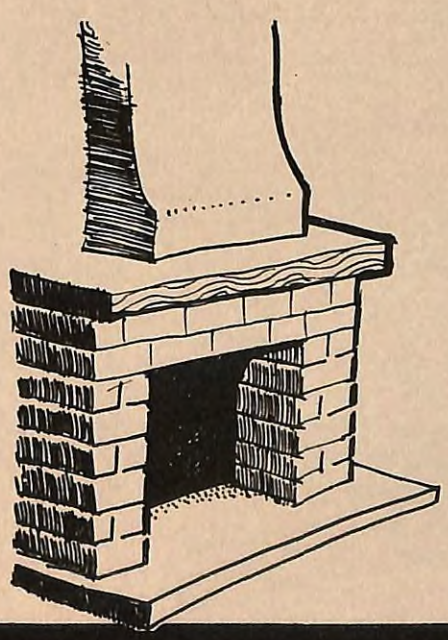
## OPEN HEARTH SURGERY



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Richard Kadulski

## FROM THE PUBLISHER

As I travel around the country, I am often asked how SOLPLAN REVIEW is doing.

I am pleased to bring to your attention that this issue marks the end of the second year of publication. Contrary to the expectations of some, there is plenty of material - technical issues in the building industry have not yet been resolved. (Will there ever be a time that there is no progress or innovation?)

There is always some new product or situation that requires investigation, and the need to communicate and comment on what is going on. There seems to be a need for an independent vehicle of information. That is what we are trying to do, and judging by your response, we are managing to do that reasonably.

We had some concerns about the heavily funded publications being supported by various organizations and government departments that have started to appear lately, but the more we see, the less our concern (but we question the amount of money directed their way).

As a business venture our effort is still almost without merit (which is why there is not a lot of private competition out there) but at least we're covering out of pocket costs. A subscription based publication, not indebted to the advertiser, is difficult to maintain. That is why we are hoping our readers will continue to assist us in spreading the word about our existence. It is our resolve to keep on with our efforts for many more years.

It's also a lot of fun for us!

Richard Kadulski
Publisher

### NATIONAL BUILDING CODE CHANGES

Even though the 1985 Edition of the National Building Code of Canada has not yet been implemented in all jurisdictions, work is underway on proposed changes for future editions.

A number of changes currently being considered will be available for review on January 15, 1987. Public forums are being planned to explain and allow more direct discussion on the intent of proposed changes, so that there is a better understanding among the community directly affected.

Anyone who has any concerns about the code and changes they would like to see, should contact:

R.H. Dunn, Acting Secretary, Associate Committee on the National Building Code, Institute for Research in Construction, Ottawa, Ont. K1A 0R6. Tel 613-993-9960

### 1987 EEBA CONFERENCE POSTPONED

As we went to press, we received information that the **5th annual Energy Efficient Building Conference and Exhibition** (also known as the 'Rochester conference'), which was scheduled for April 9-12, 1987 in Seattle, Wa. has been postponed to later in the year. In the past this conference has been a major North American forum for the exchange of information and ideas related to low energy construction.

Details of alternate arrangements were not available at press time. As we receive more information, we will keep readers posted.

SOLPLAN REVIEW is published 6 times per year by The Drawing-Room Graphic Services Ltd. P.O. Box 86627, North Vancouver, B.C. V7L 4L2. Tel: 604-689-1841
ISSN: 0828-6574 Printed in Canada
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SUBSCRIPTIONS: $24.00 per year in North American. Overseas rates on request.

Unsolicited contributions and manuscripts welcome. Include self addressed pre-stamped mailer if return requested, Publisher is not responsible for loss or damage of same.

Second Class Mail Registration No. 6855

Date of Issue: January 1987



## OPEN HEARTH SURGERY

The warm glow of the crackling fire, the quintessence of homey comfort, has been relegated to an audio-visual representation by most commentators on low energy housing. The open hearth is either diagnosed as a net energy loser and curable only by outright removal or by transplanting a metal, glass-doored, fan-vented contrivance to make best of a flawed technology. Yet, since man's successful quest for fire up to this century, we have relied on nature's renewable bounty to keep the blood flowing in our extremities when all else has frozen solid, and this largely by basking in the glow of embers.

Why has our technological sophistication led us to conclude that the cherished fireplace cannot warm our houses where our ancestors succeeded? Simply put, the design challenge is to:

1. provide the conditions for sustaining complete combustion
2. allow efficient transfer of heat to the dwelling and occupants
3. vent the products of combustion

If the flow of cold make-up air for venting is large and passes through the occupied area, the heat delivered from the fire may not adequately maintain comfort except for someone curled up in front of the fire receiving radiant heat and shielded from the drafts. The Inuit igloo addresses the problem with a raised platform surrounding the hearth pit so that make-up air enters below the occupied zone and rises only as heated. The Plains Indians tepee employed a similar technique and included a covered trench leading from outside directly to the fire pit.

There are many examples from around the world of similar approaches to draft evasion. The early chimneyed fireplaces of Europe were in some ways a backward development although they afforded greater architectural versatility. The application of science to fireplace design began with Benjamin Franklin and his contemporary, Count Rumford, each addressing overall inefficiency and the tendency of fireplaces to spill smoke. Franklin's solution was to affix doors to be opened when a full blaze was reached and to provide an outside air supply directly to the firebox. Rumford, whose principal attention was to remedy existing fireplaces in European mansions, introduced the shallow hearth for maximum radiant output, the streamlined narrowing to the throat, and the smoke shelf. Franklin's invention led to the wood stove and Rumford's to the modern masonry hearth but the full potential of their insights has rarely been realized (recommended reading, The Rumford Fireplace - Yankee Press).

It is possible to have the permanence of the masonry hearth, the enjoyment of open flames, a smokeless room, and efficient whole house heating out of one woodburning fireplace. I have demonstrated this in a number of houses. The design principles are as follows:

1. A shallow Rumford style hearth for optimum radiant output.
2. Airtight, well insulated building construction with outside air ducted to a slot **across the full face of the hearth and sized to equal the cross section area of the flue**. The make-up air is largely supplied directly through the slot and acts almost like an air curtain with virtually no cold drafts running across the floor.
3. A means of distributing heat throughout the house (usually a forced air furnace with high air return or open floor/central hearth planning).
4. Locating all masonry within the insulated envelope including a light aggregate thermal break at the ceiling.
5. A tight sealing flue damper mounted on top of the chimney.

Heat is supplied radiantly at a high rate raising surface temperatures in the room and is subsequently convected to the rest of the house (ever notice how effectively glass doors block the heat?). If the house has a low enough heat loss, the rate of cool down is sufficiently slow that a two hour fire in the evening carries the house overnight. Total enclosure of the masonry and top sealing the flue results in absorbed heat slowly emitting to the house and warm flues for easy start up. Plans for this type of fireplace can be found in a publication by the Centre for Research and Development in Masonry, titled Energy Efficient Masonry Fireplaces.

Flue backdrafting is resolved by adequately sizing the combustion air supply. In a very tight house with balanced

ventilation, there is no need to damper the duct since cold air does not enter the house unless there is a net loss of air out of the house. It is possible to backdraft such a fireplace with a sufficiently high rate of powered exhaust (as is the case with some kitchen range exhaust fans). It is advisable to provide a make-up air intake specifically for such devices or avoid them. Glass doors, in any case, may not prevent backdrafting under extreme depressurization of the house.

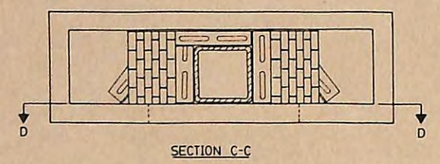
I recognize that advocating the open hearth runs against current directions such as the R-2000 Program's mandatory requirements for sealed doors on fireplaces and the work underway on a CSA Fireplace Standard. It would seem wise to raise concerns before we lose the possibility of better solutions to fireplace design. Are we willing to relinquish the pleasures of the bear skin rug so readily?

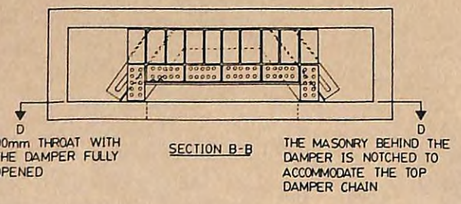
*Greg Allen is a Toronto engineer who has been actively involved with low energy building technology for the past 15 years.*

**Fireplace Technology** in an Energy Conscious World ($12.00) is another excellent source of information on all aspects of fireplace design and construction. Every mason and builder should be familiar with this book, which is based on the latest research findings. Copies of **Energy Efficient Masonry Fireplaces** and **Fireplace Technology** should be available from your local Masonry Institute.

Reprinted from **Energy Efficient Masonry Fireplaces**

In figures 1 & 4 the depth of the firebox is 400mm (16"). We recommend that this depth be adopted as the standard although it has been demonstrated that a fireplace with a firebox as shallow as 335mm (13") performs satisfactory. Depths greater than 400mm (16") will considerably reduce the energy efficiency of the fireplace.
The chimney should be insulated through unheated attic space, up to the chimney top closure if possible, so as to reduce the heat loss through the chimney walls, figure 2.

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90mm THROAT WITH THE DAMPER FULLY OPENED
SECTION B-B
THE MASONRY BEHIND THE DAMPER IS NOTCHED TO ACCOMMODATE THE TOP DAMPER CHAIN

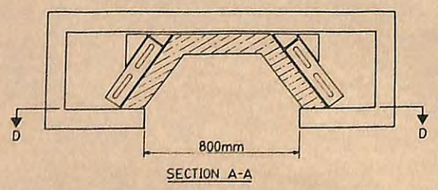


Figure 1

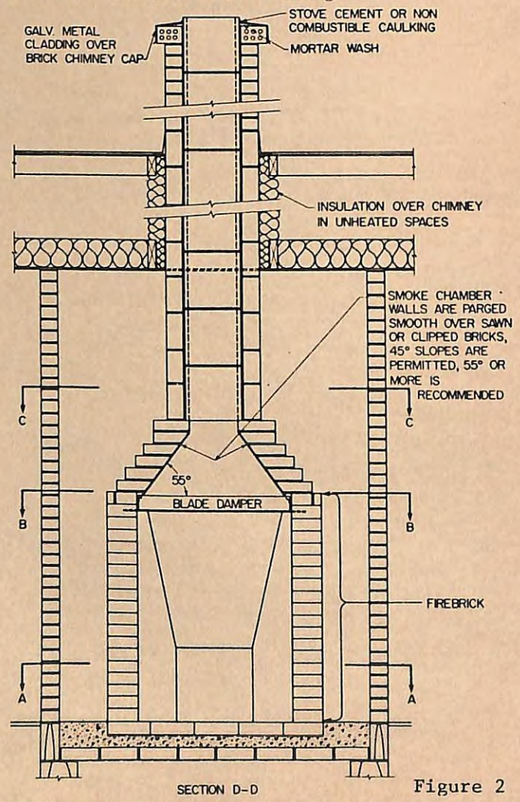


Figure 2



Reprinted from **Energy Efficient Masonry Fireplaces**

When the firebox is installed through an exterior wall, figure 4, the firebox should be heavily insulated in order that the fireplace may achieve the energy efficiency for which it is designed. In such instances the total depth of the fireplace is 800mm (32").

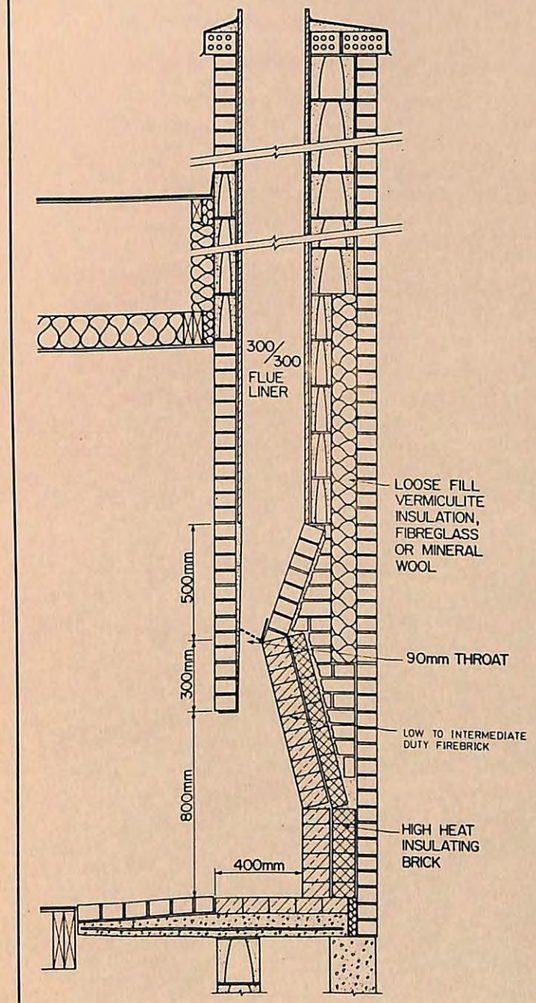


Figure 4

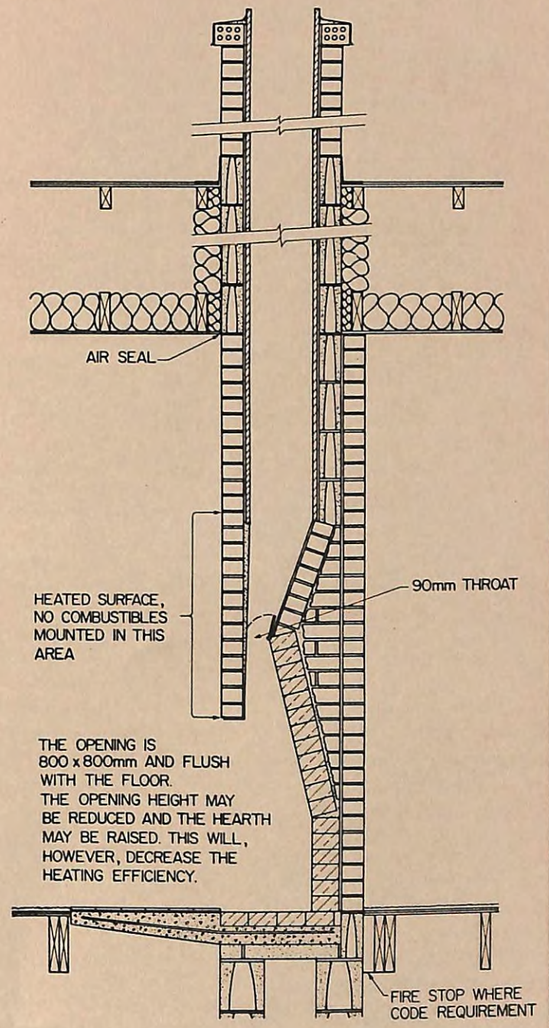
AIR SEAL
HEATED SURFACE, NO COMBUSTIBLES MOUNTED IN THIS AREA
90mm THROAT
THE OPENING IS 800 x 800mm AND FLUSH WITH THE FLOOR.
THE OPENING HEIGHT MAY BE REDUCED AND THE HEARTH MAY BE RAISED. THIS WILL, HOWEVER, DECREASE THE HEATING EFFICIENCY.
FIRE STOP WHERE CODE REQUIREMENT

Figure 5

# VENTILATION: HOW MUCH IS ENOUGH?

There has been much discussion recently about how much ventilation is necessary to provide a safe and comfortable indoor environment. R-2000 Program standards have been criticized for being too high, leading to over-ventilation of houses.

ASHRAE (the American Society of Heating, Refrigeration & Air-Conditioning Engineers) has just issued a draft copy of a ventilation standard which proposes to *increase* required ventilation rates to 15 cfm per person. In smoking areas it is even suggesting higher rates: 20 cfm for offices, 35 cfm for bars and cocktail lounges.

The object of any standard is to specify minimum ventilation rates and indoor air quality which will be acceptable to human occupants, to avoid unhealthy conditions.

The ASHRAE standard is based on the need to dilute occupant generated carbon dioxide to a proposed level of not more than 0.1%. Until now ASHRAE's permitted level of $CO_2$ was 0.25% (the level of $CO_2$ in outdoor air is about 0.03%).

It is interesting to note that this new figure was arrived at as being the amount of outdoor air needed to dilute indoor air to a level acceptable to 80% of the visitors first entering the space.

In the case of residences, the proposed standard requires mechanical ventilation of 0.35 air changes per hour, but not less than 15 cfm per person. At the same time, it calls for kitchens to have exhaust capacity of 100 cfm, and bathrooms 50 cfm.

It was not until the late 1600's that the source of bad air was recognized to be pollutants generated by people. After the discovery of $CO_2$, it was observed that it could be used as a measure of air quality. In 1845 theoretical calculations were made, based on the calculated size of a human lung, that the minimum ventilation requirement (based on $CO_2$ build up) was 10 cfm.

In 1900 the first ventilation standard proposed (for schools) called for 30 cfm per person of outdoor air. This was based on odours being a major indicator of quality - although another study in 1913 showed that even at 50 cfm there still were odours.

Another study showed that 5 cfm was the low limit of acceptable air quality.

If this all seems somewhat arbitrary, it should be remembered that indoor air quality is a relatively new field, and much trial and error as well as serious study has to be done before there can be a reasonable agreement on what constitutes a healthy indoor air quality. The key questions still are *Just how much ventilation is required? How best can one provide it? Which pollutants should be controlled by ventilation, and which by removal of sources?*

In setting standards, past experience will have to be considered, and not just theoretical calculation. If there are complaints of over-ventilation, they should be investigated, and considered. (The R-2000 Program in fact is decreasing required ventilation rates).

One other consideration that must be given is the quality of *outdoor* air that is the source of the 'fresh air' for the indoor. It is always assumed that the outdoor air is better than that inside. But is that <u>always</u> the case, especially in some of our cities?



# R-2000: NEW VENTILATION STANDARDS

**R-2000 PROGRAM TECHNICAL STANDARDS: PROPOSED NEW VENTILATION STANDARDS**

The need for adequate ventilation in residences has been a key feature of the R-2000 program.

The ventilation requirement is based on the need to control the level of carbon dioxide and other contaminants generated by occupants or by sources with no fixed identifiable location by dilution through mixing of outdoor air with room air, as well as removing contaminants generated at fixed locations (such as bathrooms and kitchens).

Until now, the requirements have called for a demonstrated capability to supply 0.5 air changes per hour or a minimum of 100 cfm (whichever is greater) of continuous variable speed controlled mechanical ventilation.

These standards meant that large houses required excessively large ventilation systems, with no demonstrated need for such large volumes of air flow. For instance, a 4000 square foot 3 bedroom house required considerably more ventilation than a 900 square foot, 3 bedroom house that could well be occupied by the same 3 or 4 people (yet one assumes each would have the same basic ventilation needs).

In fact, a very small house might actually require more air (as a proportion of its total volume) than a very large house.

As a result of these realities, and careful monitoring of the first several hundred houses in the program, it has been recognized that a more realistic approach to take is to look at the occupancy of the house (based on number of rooms) rather than just the total volume.

**NEW VENTILATION REQUIREMENTS**

The proposed new requirements call for a ventilation *capability* to provide a minimum supply of ventilation air, distributed to each room, on a continuous basis, at a rate of 10 cfm (5 l/s) to each habitable room, bathroom, and kitchen, and 20 cfm (10 l/s) to basement areas and utility rooms. In addition, an additional intermittent capacity of 50 cfm (25 l/s) is required to control excess humidity or contaminants. This is to be activated by a humidistat and a manual override (or timer).

However, the required continuous ventilation rate need not be greater than 0.45 air changes per hour based on total heated house volume. This is of special interest for small houses, which on a room count could require much more ventilation than .5 ACH. On the other hand, a large house with a few large rooms could have a ventilation requirement well below 0.4 ACH.

The exhaust capacity must be able to provide exhaust from the kitchen and at least one bathroom at the same time. Thus even though the peak exhaust capacity required may be high (if there are a number of bathrooms) it is not necessary to assume that they will all operate at the same time. This means that a central ventilation system need not necessarily provide total peak exhaust capacity.

The requirements contain considerable detail (they are written in a 27 page document), and include definitions, ventilation system installation quidelines, system performance and compliance, start-up procedures, as well as procedures which help to determine make-up air requirements, for measuring airflow rates, and examples of ventilation systems.

Most installation procedures for HRV's are covered by the CSA HRV standard, except that fresh air intakes are to be located at least 18 inches above the finished grade. This could be a problem in the case of houses where the main floor level is located near finished grade and the HRV is located in the basement or crawlspace.

**MAKE-UP AIR NEEDS**

Ventilation systems must be balanced. <u>Unbalanced</u> air flows, such as could be caused by bathroom exhaust fans, kitchen ranges, clothes dryers, or central vacuums (external exhaust) must not create a pressure difference across the building envelope of more than than 10 Pascals (0.04 inches w.g.) if operated continuously, or more than 20 Pa if operated occasionaly. Such pressure differences across the building envelope are difficult to measure, so the guidelines provide several alternative means by which make-up air can be sized. This means that make-up air may be required if some of these exhaust sources are

provided (or in exhaust-only non heat recovery ventilation strategy).

It may seem a contradiction to have to poke holes in a house after taking special pains to tighten it up. How critical is it to provide make-up air?

Studies have measured that with all exhaust fans running, an average house could easily exceed 10 Pa depressurization. Yet gas furnace flues often operate at only a 5 Pa pressure difference, and fireplaces at 15-20 Pa. So unless some provision is made, it could be easy to create a 20 Pa pressure difference across the building envelope.

**AIRTIGHTNESS STANDARD**

Up to now, the standard test has been 1.5 air changes per hour at 50 Pa. While this is still an acceptable alternate measure of the tightness, it does not do any justice to a small house which has a very large surface area for its volume, and may be difficult to tighten to meet the 1.5 ACH.

The tightness of the building envelope will now be measured in terms of the **Normalized Leakage Area** (NLA). This is a measure of the total openings in the envelope if they were to be measured and added up. The allowable new limit is 0.7 $cm^2/m^2$ (or 1 $in^2/100\ ft^2$). This is still obtained by the blower door test.

A builder who has some experience with R-2000 building will now be able, if he doesn't want to introduce unnecessary air inlets, to wait until the house has been pressure tested to determine if make-up air is needed. If the house is leaky enough, infiltration through the building envelope could meet make-up air needed to match unbalanced exhaust air so that special ducts may not be needed.

The new guidelines include several tables and charts to help with design. To make things easier, the new computer program used to evaluate houses (HOT2000) will automatically calculate an estimate of unbalanced air flow required to cause a 10 and 20 Pa pressure difference (based on the average tightness of typical R2000 houses). For example, if the print out indicates that 70 cfm will cause a 20 Pa pressure difference, and the house will contain a clothes dryer that vents at 100 cfm, then some make-up air will be required. (Most dryers vent at 80-110 cfm). However, if the blower door has shown that the house has an NLA that matches the duct area that would be needed to meet the make-up air, then nothing additional is needed.

Most builders will want to try to build-in the make-up at the time of construction, as the airtightness test is usually done on completion of the house. Having to go back after the house is finished to put in another duct just adds unnecessary cost (and an unneeded call-back).

The strategy of providing make-up air so that it does not create uncomfortable drafts is another issue. We welcome reader's ideas on how this can be done quickly and economically, and without creating uncomfortable drafts.

*The proposed new technical requirements are scheduled for implementation in October 1987. Until then, houses will be accepted into the program if they meet either the old or new criteria.*

EQUIVALENT LEAKAGE AREA PROVIDED BY INLET DUCTS OF VARIOUS SIZES

| DUCT DIAMETER | NLA(m2) |
|---|---|
| 75 mm (3") | 0.0024 |
| 100 (4") | 0.0052 |
| 125 (5") | 0.0092 |
| 150 (6") | 0.0156 |
| 175 (7") | 0.0240 |
| 200 (8") | 0.0340 |

REQUIRED SIZE OF MAKEUP AIR INLET DUCTS WHERE THE EQUIVALENT LEAKAGE AREA OF THE BUILDING ENVELOPE IS NOT KNOWN
(assuses a perfectly sealed building envelope)

| Unbalanced Airflow | | | | Required Makeup Air Inlet | |
|---|---|---|---|---|---|
| Continuous CFM | (L/s) | Intermittent CFM | (L/s) | Duct Diameter In. | (mm) |
| 20 | (10) | 40 | (20) | 3 | (75) |
| 40 | (20) | 80 | (30) | 4 | (100) |
| 60 | (30) | 100 | (50) | 5 | (125) |
| 100 | (50) | 160 | (80) | 6 | (150) |
| 150 | (75) | 250 | (125) | 7 | (175) |
| 200 | (100) | 340 | (170) | 8 | (200) |


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## PRODUCT UPDATE:

From NUTECH ENERGY SYSTEMS Inc.

Nutech Energy Systems has launched its new Lifebreath 200 MAX model Heat Recovery Ventilator. The unit has a removable aluminum core, built-in humidistat, and variable speed control. It uses a single motor for supply/exhaust air flows.

Defrosting is handled by an automatic temperature activated timed defrost cycle. The unit ventilates for about 30 minutes, then defrosts for about 2 1/2 minutes. When in defrost, a damper moves to block the cold incoming air, letting in warm house air to defrost the core. Both air streams remain on at all times. (Previous units manufactured by Nutech used a pre-heater for defrost).

Performance test results show it to have remarkably little cross contamination between exhaust and supply air flows.

The sensible heat recovery efficiency remains fairly constant at warmer and colder temperatures. ORF test results show it to be 60% at both 0°C and -25°C.

## CANRAY INC.

**LIFE-OF-STRUCTURE WARRANTY**

CanRay Inc., manufacturer of **Therma-Ray** low temperature electric radiant heating panels (reviewed in SOLPLAN REVIEW #9) has just announced a life-of-structure warranty on their radiant panels.

Of special interest is that they have made their warranty **retroactive** to include every Therma-Ray panel manufactures and sold in Canada.

CanRay, a Canadian company, has been manufacturing and distributing these panels in the USA for over two decades, so they have been around for some time, and have knowledge of their product. They now have a Canada wide distribution network.

It's not too often that a manufacturer comes up with such an expression of confidence in their product.

**UPDATE: THERMO STRUCTURES BUILDING SYSTEM**

In SOLPLAN REVIEW #5 we introduced our readers to a new expanded polystyrene insulation panel that interlocks with preformed lock edge joints to form rigid airtight panels, offering quality control to conventional stick framing. (We were the first publication to review it).

To date there has been no effort at marketing the product, other than by word of mouth and low key presentations to builders. Yet over 150 houses in the west have now been built using the system.

Readers may be interested to know that the system will be marketed in Canada by Plasti-Fab Ltd., a major manufacturer and fabricator of plastic foams, and will be known as the **Plastispan Thermo-Lock** wall insulation system.

Marketing plans in other countries are being prepared. (The system is patented world-wide).

## NEW: SUPERSTUD

Energy efficient building products are continuing their evolution. The latest product, and one that has a lot of promise is the new SUPERSTUD which is about to be manufactured in B.C.

What is a SUPERSTUD? it's a manufactured, insulated stud.

We pay much attention to the insulation levels in wall framing. Various ways of putting together frame walls have been developed, but we often forget that the surface area of a typical frame wall can be as much as 20% or more solid wood, made up of studs, plates, headers, etc. Yet we need to have a structure to hold up the house!

So what can we do?

Ta-da! Along comes the SUPERSTUD. It is an insulated stud that significantly reduces the thermal bridging of a solid piece of wood.

It looks a bit like a miniature insulated plywood web joist, with the both sides of the web filled by polystyrene insulation.

The SUPERSTUD is strong (it's engineered), light (using less solid

## RENOVATION WARRANTY

material), straight (it's factory assembled from kiln dried wood, thus no shrinkage, checking, or warping).

It is expected that the price of the SUPERSTUD in southern BC will be competitive with conventional framing lumber. The manufacturer is planning to have floor joists and variable length units as well.

Looking at it from a broader perspective, the SUPERSTUD has a couple of side benefits. The unit uses smaller pieces of wood, so that better wood utilization can be made.

Because of quality control available to factory production, and the composite nature of the stud, it is possible to use lower grade lumber without loosing any structural strength, yet keep the product cost competitive. This will allow the wood industry to get better lumber utilization.

As the SUPERSTUD is light, shipping costs are reduced. Framers will love it because they are so light and easy to handle. Drywallers will like it for the uniform dimensions and straighter framing.

Since the studs are insulated, thermal bridging is substantially reduced.

Disadvantages? Sure, there are some. The major one is the limitation on dimensions. If you want to frame a vaulted ceiling, dormers, or other off-size elements, it could be difficult, as the studs only come in manufactured dimensions, and they cannot be site cut to what you need. But where you use precut studs now, this could be the alternative.

Ready to order? Sorry, they're not available just yet. The product developers have plant equipment on order, are building their first plant in Parksville, B.C., and finalizing their marketing and financing arrangements. For the moment, as part of the development process, units are being hand assembled for demonstration and test houses.

The product was shown at the Alberta-B.C. CHBA convention this fall, and has aroused interest far in excess of expectation.

We'll keep readers posted of developments as they happen.

The renovation industry has had a bad image, especially the insulation retrofit industry. To overcome this, a new Contractors' Warranty program has been launched. Seed funding has come from Energy Mines & Resources Canada.

Consumers using warranty registered contractors will receive warranty protection in areas of insulation, ventilation, air sealing, windows, doors, insulated siding, warning and control devices. While individual contractors and manufacturers generally provide some warranty protection on services and supplies, consumers are often not able to recover losses as a result of fraud or insolvency.

The new warranty program covers a lot of grey areas which previously left the homeowner out.

The key components of the warranty include:

1. **Liability protection** to cover losses not currently covered by contractors.
2. **Deposit coverage** to a limit of $1000 to reimburse consumers on deposits paid to secure jobs which a contractor is unwilling or unable to perform.
3. **Completion coverage** up to $5000 should a contractor fail to complete a job.
4. **Material/workmanship coverage** up to $5000 to correct defects in workmanship or material which contractor or manufacturer is unable or unwilling to resolve.
5. **Standard contract forms** as evidence that contractors are conducting business according to agreed upon conditions.

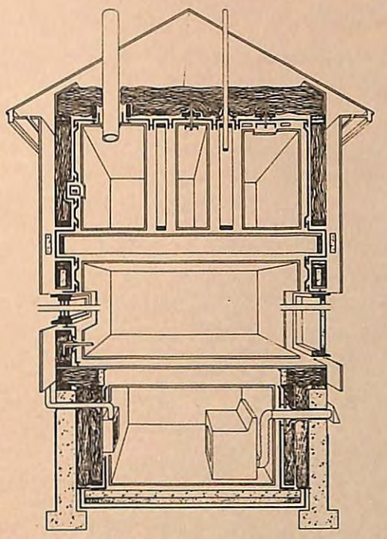
To be eligible for participation in the program, contractors and manufacturers will have to qualify in areas of business conduct, technical competence, financial stability and quality of workmanship. They will also be required to participate in training session related to state of the art expertise in energy conservation.

This is a national program, that should go a long way to overcoming image and quality control problems of the industry. The premiums will run around 1-2% of contract value.

For information, contact:
Energy Conservation Contractors Warranty Corp.
2B-7291 Victoria Park Ave. Markham, Ont. L3R 3A4
(413)-479-5666



## BOOKS



11-31. Polyethylene air/vapor barrier.

**Superinsulated Design and Construction: a guide to building energy-efficient homes**
by: Thomas Lenchek, Chris Mattock, John Raabe

As energy efficient design has matured over the last decade, architects, designers and contractors have found that the best energy conservation techniques are also the simplest. Good insulation, south orientation for windows, and paying close attention to construction details are more cost effective than complicated solar or earth sheltered strategies.

These simpler energy efficient measures, as all R-2000 builders are aware, are less restrictive on design.

**Superinsulated Design and Construction** is a practical volume for architects and builders, providing all that is needed to design and build super efficient housing.

The book opens with a discussion of fundamentals: basic building science, energy efficient home concepts, energy use and heat loss. Excess moisture and indoor air quality can be special problems, so potential sources and problems and methods of dealing with then are discussed.

Design considerations covered include principles of building shell design, types and evaluation of various insulation materials, and site and building orientation. The overview of mechanical systems presents a good review of various ventilation strategies. Methods of analyzing energy and economic data for various features to determine cost effective options are presented.

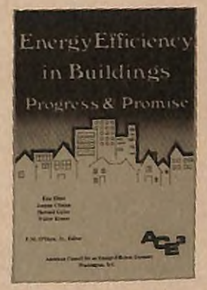
The final section is a presentation of various construction details in energy efficient homes. All sections are very well illustrated by clear easy to read sketches.

If this book sounds like the **R-2000 Builders' Manual**, it's because there are many similarities. Chris Mattock, who has been involved with low energy building for over 10 years, was also a member of the team that developed the R-2000 manual.

We would like to recommend that everyone rush out and get their own copy, however, at the Canadian price of $52.45 it is pricey. This book has been targeted at the USA market (where the US price of $34.95 is more reasonable). However, architects and contractors (as well as libraries) will find this a valuable reference book - especially if they do not have a copy of the R-2000 Builders' Manual.

Superinsulated Design and Construction: a guide to building energy-efficient homes
by: Thomas Lenchek, Chris Mattock, John Raabe; 192 pages, hardcover, 239 illustrations. Pub. VanNostrand Reinhold. ISBN 0-442-26051-2

On request copies will be available from The Drawing Room.




**Energy Efficiency in Buildings: Progress and Promise** published by the American Council for an Energy Efficient Economy is a new book that documents the dramatic impact of energy conservation in buildings over the past decade.

Why another book on Energy efficiency

when oil supplies are abundant, prices low, and OPEC in chaos?

The current situation will change within a few years because nonrenewable energy sources are finite and the likely growth of the world economy which will impact on everyone. USA oil reserves are already falling, and at current production levels only nine years of reserves are available. In 1984 the USA, the biggest economy in the world, was already importing 30% of its oil.

Further increases in energy efficiency will stretch supplies of nonrenewable resources, and cushion the economy against future price hikes. Improved efficiency can drastically reduce operating costs of buildings, reduce investment requirements of electric utilities (thus keeping hydro-electric rates low), increase local and regional employment, reduce adverse effects of fuel extraction, transportation and conversion.

Energy conservation has been a major factor in creating the present oil 'glut' and stable oil prices. The largest oil reserve uncovered in the past decade was not pumped out of the ground. Rather it was incorporated into homes, appliances, commercial buildings, vehicles and factories. The building sector is an especially important component of the resource.

The book examines the technological advances, behavioural changes, and programs initiated to stimulate improvements in residential and commercial buildings. Equally important for future conservation, the book identifies ways to save even more energy by taking full advantage of recent breakthrough and by developing technologies. For example, if all household refrigerators were as efficient as the current top rated models, the USA would need at least 10 less large power plants. Improving refrigerator efficiency to cost effective limits would save another 5-10 power plants.

This book is meant to be a reference book, rather than a text, and is completely devoted to the United States scene. However, if offers an interesting insight on the directions energy efficiency is taking, and what impacts it can have on society at large. While we in Canada may be insulated from the severe impacts of resource depletion for the short term, we must not fool ourselves. Our turn will come, but later.

It would help if we kept a watch on what is happening elsewhere, so that we can be ready.

Energy Efficiency in Buildings: Progress and Promise
F.M. O'Hara Jr., Ed. published by the American Council for an Energy Efficient Economy, Washington D.C.
ISBN 0-918249-04-X
US$19.50 (Canadian$ 27.50)

On request copies will be available from The Drawing Room.

## LETTERS TO THE EDITOR

Sir,
Re: Air Leakage Through Polyethylene: Test Results (SOLPLAN REVIEW #11)

The conclusion reached, based on NRC lab tests that polyethylene cannot be relied upon as an adequate air barrier, flies in the face of field evidence. Although I am not aware of long term testing of air barrier integrity of houses employing caulked polyethylene, there are sufficient air leakage measurements using fan depressurization to support claims of efficacy. I have had tests performed on several houses - some having been completed for over a year - with air leakage rates of less than .5 ACH at 50 pascals. What, then, is the discrepancy with NRC lab tests?

First off, conventional polyethylene air barrier techniques involve lapping acoustical caulking, stapling through the caulking, and strapping a drywalling over the joint - an assembly that was not even cited. The test employing drywall indicated excellent performance without even caulking; so where's the beef? I gather the test employing caulking did not include stapling, a practice I have never seen a builder employ since the sheets would simply fall down.

As for polyethylene experiencing 2000 Pa pressures in the field, it would be useful to verify this in reality. Since walls are an assemblage of various layers, each acting as a partial air barrier, the maximum pressure differential across the wall is greater than across the polyethylene alone. In fact, with a reasonably tight sheathing or taped Tyvek, the polyethylene may experience insignificant pressure (I have observed this during construction under high winds).

I must conclude that the relation of the NRC test protocol to actual construction is marginal at best and has led many to erroneous conjectures. Polyethylene is not being ripped out of walls and ceilings. Certainly, there are valid concerns regarding quality control of the material which are being addressed. Large unsandwiched expanses of polyethylene make admirable sails so that certain unusual assemblies could fail. To this extent, there are valid concerns raised in this article.

I am not suggesting that there is no value in considering other means of achieving an adequate air barrier, but the evidence does not exist to suggest that polyethylene when properly detailed and executed is inadequate. Years of experience in Europe and North America have established the ease and practicality of polyethylene air barriers.

Consider the possibility that physical separation of air and vapour barriers may permit moisture to transfer via vapour diffusion through the air barrier, then pass by convection around the vapour barrier. Another issue, I have heard rumour of, is that the use of paint as a vapour retarder over a drywall air barrier can result in paint peeling due to summer vapour pressure differentials opposite to the winter conditions. Before we go advocating radical departures from conventional practice we should carefully assess the ramifications of the new systems.

The curtailment of building research activities at NRC is short-sighted and probably a costly error in judgment by the federal government. Construction being the largest economic activity of the country, the consequences of inadequately researched practices may be very expensive. Prudence in judgment is called for and we must rely heavily on our wit, observations, and dialogue to bolster scanty research in seeking the better way.

Greg Allen, P.Eng.
Toronto, Ont.

*(2000 Pa pressures on a building envelope have been measured by NHC investigators. These are peak instant loads which are not be frequent, and are caused primarily by wind gusts (although stack effects and fan pressurization within the building also contribute). They usually apply to the upper portions of a high rise building but a residence in a exposed location could be subject to such conditions. Ed.)*

Sir,

Richard Lay's comments in the Oct-Nov. 1986 issue of Solplan Review are very good. However, I still feel that extreme caution must be exercised when designing swimming pool building envelopes. As Mr. Lay points out, there are micro climates created in buildings. Producing these micro climates can be both beneficial and harmful to the owner. While blowing air over a window does increase the inner glass surface temperature by destroying the air film on the glass it also significantly increases the heat loss through the window.

If a pool space is maintained at 80°F dry bulb and 60% RH the air has a dew point of 65°F. Using standard double glazed windows (U=0.53) and inner air flow across the window at 1320 fpm and a -40°F outside air temperature the inner glass surface temperature will theoretically be 65°F. If there is no air flow across the inner window glass then the surface temperature will be 37°F, well below the dew point. It should also be pointed out that few, if any, window frames have as high an R-value as the double pane glazing unit and this results in an edge effect that reduces the surface temperature of the glass near the frame. Another factor that causes glass surface temperatures to fall below those calculated by using published U values is nighttime radiant heat loss. I have seen many installations where condensation has occurred on the window frame and on the glass near the frame while the centre of the glass is dry, including installation where air is blown up across the window (from floor grilles). Window frames also "shadow" glass and cause very local stagnant air pockets.

I have also seen many instances where the return air/exhaust air relative humidity is at say 30-50% and there is still condensation occurring on the inner surfaces of walls particularly in corners. Corners, and

similar areas, quite often have fairly stagnant air conditions and also lowest wall R-values due to the intersection of building structural/framing components and consequently a micro climate that causes condensation is produced.

After 25 years in the HVAC business I'm afraid I've become a bit of a sceptic insofar as the industry's ability to build a building that can tolerate internal air moisture contents much greater than 0.004 - 0.005 lb/lb when -30°F to -40°F outside air temperatures occur.

Donald E. Holte, P.Eng
Nova Engineering Ltd.

## BACKDRAFTING

### BACKDRAFTING OF FURNACES

Is your new house a health hazard? If you have built a house with a combustion appliance (gas or oil furnace and/or hot water heater, fireplace, indoor barbecue, etc.) you may have built a gas chamber!

Is this an overstatement? Media sensationalism? We don't think so. Every year in Canada several dozen people die from asphyxiation as a result of poorly vented appliances. Many others just suffer from contaminated air.

The tight houses we are building today may be a hazard to their occupants; the major source is the backdrafting of chimney flues. A recently completed study for CMHC has indicated that many houses suffer to some degree from backdrafting. In some cases it can be serious.

Just what is backdrafting? it's the reverse flow of exhaust gasses from a fire, so that instead of going up the chimney, they go into the room where appliance is located. Everyone's experienced the smoke spill from a fireplace when it's being lit, until a draft is established. Hot exhaust gasses are pushed up the flue by a draft created by the pressure difference caused by a temperature difference. However, the pressures involved may be quite small: a gas furnace flue on a calm winter day quite often will only have a 5 Pascal pressure. A fireplace operates at 15-20 Pa.

The observant reader will note that the fireplace could overpower the furnace flue in some conditions, especially if the house is at neutral or slightly negative pressure, and the fireplace does not have an adequate separate fresh air source.

If you look at the top of a typical gas furnace or hot water tank, you will note that the flue is not sealed, and there is ample opportunity for gasses to spill backward into the house (this is by design, so it is not appropriate to seal the hood!). If the house is depressurized, the open flue can act as a make-up air duct for the house. If there is not enough draft established in the chimney even while the furnace is running, the exhaust gasses will just spill into the furnace room.

How critical is this? How often does this happen? A new house or one that's been tightened up in a retrofit can be very tight. If balanced ventilation and adequate make-up air is not provided then any combustion appliance inside the house could be a major problem. The most common reason so many R-2000 'clones' are being built is that builders and homeowners are trying to avoid having to provide the extra ventilation and make-up air needed.

A typical fireplace needs about 250-400 cfm of air for combustion; a cooktop barbecue type range exhausts about 200-300 cfm or more; an ordinary range hood can exhaust up to 200 cfm. Any one of these can induce depressurization; if operated in combination with another appliance such as bathroom fan or dryer, without adequate make-up air, depressurization of up to 10 Pa is easily achieved. One documented case achieved 19 Pa!

There is evidence that depressurization as low as 2 or 3 Pa can induce severe spillage from a poorly designed chimney. Many chimney flues are poorly built and maintained. If the flue is not tight (and insulated), it is more difficult to establish adequate drafts and there is more chance for dangerous spillage incidents to happen from time to time.

How severe are the health hazards? Most combustion by-products are carbon dioxide and water. Occasional high concentrations of these will not do severe damage but are not desirable. If combustion is not complete, and the gasses spill, toxic concentrations of carbon monoxide(CO) are possible. CO is dangerous because it has no smell or colour (but it's always present in wood smoke) - and toxic concentrations are very low, and increase with low temperature smoldering fires.

Many of the problems associated with backdrafting are in older houses that have been tightened up. However, new houses are subject to problems also.

Problems can be avoided by ensuring there is adequate make-up air to provide balanced ventilation at all times: this includes adequate combustion air to the fireplace; by providing a warm air register into the furnace room; and ensuring that chimney flues are tight and insulated. Best yet, use direct vented or sealed combustion appliances.

### NATURAL GAS FIREPLACES

Natural Gas fireplaces have become very popular recently, in part due to a major marketing campaign by the gas utilities. (B.C. Hydro reports that during July, a slow month for heating sales, over 1,000 units were sold in Greater Vancouver alone).

Not all gas fireplace units are uncoupled from the indoor space (by means of sealed glass enclosures) or equipped with direct make-up air into the combustion chamber. Those units which do not have either can backdraft very easily.

Anyone planning to purchase a unit should consider how combustion air is supplied to the unit. Our choice would be for the completely sealed units.

## LEBCO COMMENTARY

Earlier this year SESCI presented a brief to the Federal Minister of Energy. Among the points made it suggested that as a result of the severe cutbacks to federal spending programs (including closing the NRC Division of Energy), the impression was created that energy conservation was no longer to be treated seriously. However, there is still a long way for us to go!

We have noted that Marcel Masse, Minister of Energy has recently recognized the importance of conservation. The economics of conventional energy will ensure that in the next few years we will be looking even closer at alternate energy/conservation options.

We would like to propose the introduction of an energy performance standard in the Building Code. (At the moment, there is no such requirement). New strategies can be cost effective and have a major impact on building performance.

Since it takes a long time for a Code to be implemented, its impact is phased in over time as building stock is built and renewed. Everyone has ample time to prepare for the criteria, so any cost increment is not imposed suddenly. In fact, the time provides the opportunity for suppliers to gear up to the potential market. If Code changes are promoted by the Ministry of Energy, such changes can have far reaching impact at no cost to the treasury.

For example, if the Code were changed to require that windows have a minimum R-value of R-4, we would see a big reduction in the price of windows meeting such standards. The technology is already available, but the marketplace is too fragmented and lacks incentive. Those producing better products now are getting a high price because it is being sold as a premium item. In the Vancouver area, until about 1974, most windows were single glazed. After the 'energy crisis' when everyone started demanding double glazing, the incremental cost difference fell substantially.

The Canadian window market is fragmented among many small regional companies (we have no major companies, as in the USA) as well as being protected by a duty, so the inertia against implementing technological change is strong. In the US, Andersen windows, one of the majors, is going to start using low e double glazing exclusively in their products. With their large production runs, incremental costs are estimated to be only 5% higher (for a much superior product).

Canadian superwindow technology is a world leader, however the marketplace incentive is not yet there to allow it to progress. Can we afford to loose it?

## NEED MORE INFORMATION?

If you would like more information about any products or publications mentioned in this issue, let us know, and we will forward you name.

* EEBA Conference
* Energy Efficient Masonry Fireplaces
* Fireplace Technology Book
* Lifebreath 200 MAX
* Canray Inc.
* Plastispan Thermo-Lock
* Superstud
* Energy Conservation Contractor Warranty
* Superinsulated Design & Construction Book
* Energy Efficiency in Buildings Book
* Star Heat Exchanger Corp.
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If you would like to order any of the books or publications mentioned, please include $2.00 per item for postage/handling.


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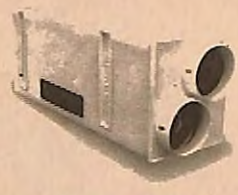

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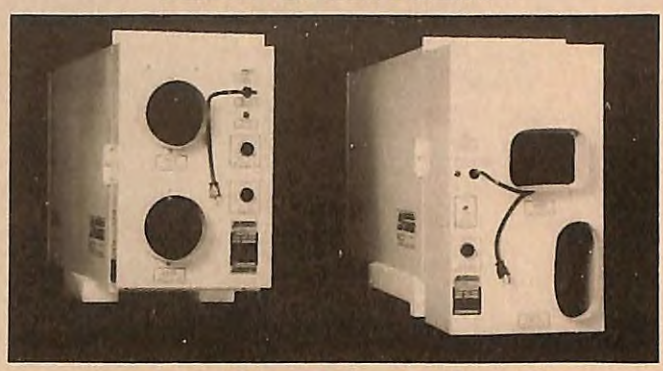

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